PETROZUATA: A CASE STUDY OF THE EFFECTIVE USE OF PROJECT FINANCE

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Companies are increasingly using project finance to fund large-scale capital expenditures. In fact, private companies invested $96 billion in project finance deals in 1998, down from $119 billion in 1997 largely due to the Asian crisis, but up more than threefold since 1994 (see Table 1). The decision to use project finance involves an explicit choice regarding both organizational form and financial structure. With project finance, sponsoring firms create legally distinct entities to develop, manage, and finance the project. These entities borrow on a limited or non-recourse basis, which means that loan repayment depends on the project's cash flows rather than on the assets or general credit of the sponsoring organizations. Despite the non-recourse nature of project borrowing, projects are highly leveraged entities: debt to total capitalization ratios average 60-70%, but can reach as high as 95% in some deals.[1]

The interesting question here is why firms use project finance instead of traditional, on-balance sheet corporate finance. While recent research has made progress in answering this question, confusion and misconceptions remain. Indeed, many of the reasons for using project finance cited in textbooks, by practitioners, and by academics alike are incomplete, if not wrong. For example, people claim that project finance allows firms to isolate project risk, to increase equity returns, to preserve (or expand) debt capacity, and to mitigate sovereign risk.[2] Upon closer examination, it is not difficult to see the shortcomings of each supposed benefit. The first benefit, isolation of risk, is similar to the "free lunch" fallacy surrounding the use of convertible debt: sponsors benefit when a project succeeds, but are protected when it fails. Yet this argument neglects the benefits of "co-insurance" that takes place among a firm's different business units under conventional corporate finance. Similarly, the claim that project finance increases equity returns, while true, neglects the negative impact of increased leverage on equity risk. The last two benefits—expanded debt capacity and reduction in sovereign risk—require explicit assumptions that are rarely stated. The benefit of expanded debt capacity results from a change in asset composition, improved corporate governance, and improved efficiency. Finally, the benefit of reduced sovereign risk occurs not because the debt is broadly syndicated (in fact, corporate debt is also widely syndicated to international banks), but rather because the project's highly-leveraged, stand-alone structure increases the likelihood that sovereign interference will result in default and value destruction. By making the project more vulnerable to default, this structure, somewhat paradoxically, deters expropriation in much the same way high

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1. For an overview of the project finance market including an analysis of funding sources, leverage, investment location, and industry, see B.C. Esty, S. Harris, and K. Krueger, 1999, "An Overview of the Project Finance Market," Harvard Business School draft case study #N9-299-051, 6/4/99.

2. These four arguments, among others, are made by P.K. Nevitt in *Project Financing*, 4th edition, Euromoney Publications Ltd. (London, 1983).

TABLE 1
TOTAL PROJECT FINANCE INVESTMENT: 1994-1998*

	Project Finance Investment ($ billions)				
	1994	1995	1996	1997	1998
Debt Financing					
Bank loans	$13.7	$23.3	$42.8	$67.5	$56.7
Bonds	4.0	3.8	4.8	7.5	9.8
Equity Financing (estimate)[a]	10.8	18.9	29.4	44.2	29.4
Total Investment	28.5	46.0	76.8	119.2	95.9
Average Debt to Capital Ratio	62%	59%	62%	63%	69%
Number of projects					
with bank financing	n/a	n/a	341	407	419
with bond financing	n/a	22	19	25	43

Source: Project Finance International.
*Some of the growth in total investment may be attributed to improved data collection methods.
a. Based on the average debt/equity ratios for a subset of new projects.

leverage deters unions from expropriating corporate wealth. The involvement of bilateral and multilateral agencies further mitigates sovereign risk by providing a mechanism for retribution against expropriating nations.

Given the limited understanding of why and how project finance creates value, the purpose of this article is to analyze the costs and benefits of project finance and to show how properly structured deals can lead to superior financial execution and greater value creation. In a recent article in this journal, Richard Brealey, Ian Cooper, and Michel Habib (1996) argued that project finance creates value by resolving agency problems and improving risk management.[3] I agree with their hypotheses in principle. But, like another article published over 10 years ago in this journal (by John Kensinger and John Martin),[4] I take a more general view of the problem. Briefly stated, my argument is that, in the right settings, project finance allows firms to minimize the *net* costs associated with market imperfections such as transactions costs, asymmetric information, incentive conflicts, financial distress, and taxes. At the same time, it allows firms to manage risks more effectively and more efficiently. These factors make project finance a lower-cost alternative to conventional, on-balance sheet, corporate finance.

Instead of presenting a theoretical argument, I illustrate the effective use of project finance by means of a detailed case study of Petrozuata, a $2.4 billion oil field development project in Venezuela.[5] Petrozuata is a joint venture between Conoco, then part of DuPont, and Maraven, a subsidiary of Petróleos de Venezuela S.A. (PDVSA), Venezuela's national oil company. It is the first in a series of development projects that are aimed at "re-opening" the Venezuelan oil sector to foreign investment. When the deal closed in July 1997, it set numerous precedents in the bank and capital markets. For these achievements, virtually every publication covering project finance declared it "Deal of the Year" and one of them recognized it as "Deal of the Decade."

Although this deal, like most project financings, has its idiosyncrasies, it is nevertheless representative of modern project finance transactions and illustrative of the benefits of using project finance. In the end, what emerges is not only a case study of an extremely well-crafted and well-executed deal, but frameworks for cost/benefit and risk management analysis in a project setting. While neither the cost/benefit analysis nor the risk management analysis provides boilerplate answers for structuring future transactions, they should provide some guidance to the process.

3. R.A. Brealey, I.A. Cooper, and M.A. Habib, "Using Project Finance to Fund Infrastructure Investments," *Journal of Applied Corporate Finance*, Vol. 9 No. 3 (Fall 1996): 25-38.

4. J. Kensinger and J. Martin, "Project Finance: Raising Money The Old-fashioned Way," *Journal of Applied Corporate Finance* (Fall 1988), 69-81.

5. This article is based on B.C. Esty and M.M. Millett, "Petrolera Zuata, Petrozuata C.A.," Harvard Business School case study #N9-299-012, rev. September 23, 1998. Other information is from public sources only. A similar analysis of Freeport Minerals Company's investment in the Ertsberg project is presented by William Fruhan in Chapter 5 of *Financial Strategy: Studies in the Creation, Transfer, and Destruction of Shareholder Value* (Homewood, IL: Irwin, 1979).

TABLE 2
1996 FINANCIAL SUMMARY OF PARENT CORPORATIONS AND PROJECT SPONSORS ($ BILLIONS)

	Parent Corporations		Project Sponsors	
	DuPont	PDVSA	Conoco	Maraven
Sales	$43.8	$33.9	$20.6	$5.5
Operating Profit	20.0	18.1	1.8	3.6
Net Income[a]	3.6	4.5	0.9	1.1
Assets	38.0	45.4	13.0	10.8
Depreciation, Depletion, and Amortization	2.6	2.7	1.1	0.9
Capital Expenditures	3.7	1.9	1.6	0.6
Reserves (billions of barrels)	1.0	72.6	1.0	24.8
S&P Debt Rating	AA–	B	not rated	not rated

Sources: DuPont 1996 Annual Report, PDVSA 1996 Annual Report, and Maraven.
a. The reported statistic for Conoco and Maraven is after-tax operating income.

BACKGROUND ON THE PROJECT

In 1976, the Venezuelan government nationalized the domestic oil industry and established Petróleos de Venezuela S.A. (PDVSA) as a state-owned enterprise to manage the country's hydrocarbon resources. Twenty years later, PDVSA had become the world's second largest oil and gas company, ranking behind Saudi Aramco and ahead of Royal Dutch Shell, and the 10th most profitable company in the world. PDVSA embarked on a major strategic initiative called "La Apertura" (the opening) in 1990. In reality, this initiative was a "re-opening" of Venezuela's energy sector to foreign investment and a way to raise some of the $65 billion needed for investment.

Petrozuata, a joint venture between Maraven and Conoco (with approximately equal ownership) was created in 1993 as part of this initiative to develop the Orinoco Belt, the largest known heavy oil field in the world. Table 2 provides a financial overview of the project sponsors (Maraven and Conoco) and their parent companies (PDVSA and DuPont). The project consists of three components: a series of inland wells to produce the extra heavy crude, a pipeline system to transport the crude to the coastal city of José, and an upgrader to partially refine the extra heavy crude into syncrude. Once refined, the syncrude would be sold at market prices to Conoco under a DuPont-guaranteed off-take agreement. At the end of this 35-year purchasing agreement, Conoco will transfer its shares to Maraven at no cost.

The sponsors agreed to use $975 million of equity (40%) and $1.45 billion of debt (60%) to finance the project's $2.425 billion total cost (see Table 3 for a description of the sources and uses of funds). The financial advisors, Citicorp and Credit Suisse First Boston, used a multi-pronged financing strategy to raise debt from commercial banks, development agencies, and bond investors. In the end, the sponsors raised $450 million in bank finance and $1 billion in Rule 144A bonds, all of which was non-recourse to the sponsors following completion of the project.

The decision to finance this deal on a project basis was actually a dual decision regarding both financial and organizational structure. Although it is not the focus of this article, it is worth mentioning briefly the rationale for choosing the organizational structure they did. Instead of entering into a joint venture with Conoco, PDVSA could have built the project alone and relied on spot market transactions to sell the syncrude. But the specialized assets needed to extract and upgrade syncrude would have left PDVSA vulnerable to opportunistic behavior by downstream customers; that is, once the facility was constructed, such customers could extract "quasi-rents" by offering to pay variable costs only. Alternatively, Conoco, with downstream refining capacity, could have built the project itself. Yet Venezuelan law prohibits foreign ownership of domestic hydrocarbon resources. And so, they created a joint venture with a long-term off-take agreement as a way to encourage investment in specialized assets, limit *ex post* bargaining costs, and deter opportunistic

Petrozuata had the three hallmarks of project finance deals: it was an economically and legally independent entity; it was an operating company with limited life (35 years); and it was funded with non-recourse debt for at least part of its life.

TABLE 3
TOTAL SOURCES AND USES OF FUNDS ($ MILLIONS)

USES OF FUNDS	Capital Expenditures			
		Oil-field Development	$449	18.4%
		Pipeline System	216	8.9
		Upgrader and Loading Facilities	928	38.3
		Contingencies	177	7.3
		Other Costs		
		Financing Costs and Fees	354	14.6
		Legal and Advisory Fees	15	0.6
		Debt Service Reserve Account	81	3.3
		Other (net working capital, cash)	205	8.5
	Total		$2,425	100.0%
SOURCES OF FUNDS	Commercial Bank Debt		$450	18.6%
	Rule 144A Project Bond		1,000	41.2
	Paid-in Capital (incl. shareholder loans)		445	18.4
	Operating Cash Flow		530	21.9
	Total		$2,425	100.0%

Source: Petrolera Zuata, Petrozuata C.A. Offering Circular, 6/17/97.

behavior. Joint ownership ensures that both sponsors have the incentive to act in the project's best interest, particularly in areas where contracts would have been costly or impossible to write.

Structured in this fashion, Petrozuata had the three hallmarks of project finance deals: it was an economically and legally independent entity; it was an operating company with limited life (35 years); and it was funded with non-recourse debt for at least part of its life. These three characteristics distinguish project finance from traditional corporate finance as well as other forms of off-balance sheet financing such as securitization. Having provided background information on the project and its organizational form, I now turn to the benefits of using project finance as a means of resolving market imperfections and managing risk.

MINIMIZING THE NET COST OF MARKET IMPERFECTIONS

The starting point for analyzing how project finance creates value is Modigliani and Miller's capital structure irrelevance proposition. According to M&M, firm value should not depend on how a firm finances its investments; thus whether it uses corporate or project finance to raise funds should be a matter of indifference to shareholders. The M&M proposition is based on a series of assumptions that are referred to collectively as "perfect" capital markets. For example, there are no taxes, transactions costs, or costs associated with companies in financial distress. The real world, of course, is not perfect by this definition; it contains "imperfections." Besides taxes, transactions costs, and costs of financial distress, there are costs stemming from asymmetric information between corporate insiders and outsiders, and from incentive conflicts among managers, shareholders, and creditors. In this section, I argue that project finance creates value by minimizing the *net* costs associated with these market imperfections.

Project Finance Increases Transactions Costs

In their classic 1976 paper on agency costs, Michael Jensen and William Meckling defined an organization as "the nexis of contracts, written and unwritten, among owners of factors of production and customers." Nowhere is this definition more true than in project finance. Negotiating the deal structure, including the financial, construction and operational contracts, is extremely time-consuming and expensive. It is, in fact, the biggest *disadvantage* of using project finance. Conoco and Maraven spent more than *five years* negotiating this deal and paid more than $15 million in advisory fees (see Table 3). This sum represents 60 basis points of the $2.43 billion deal value and is approximately the same amount firms would spend on advisory fees in a

merger of equal size.[6] It does not, however, include the professional time and expenses for their own employees working on the deal. In addition to the structuring expenses, there were financing and issuance costs totaling approximately $17 million ($12.5 million for the bond issue and $4.5 million for the bank financing including underwriting, commitment, and participation fees).[7] These costs, which total $32 million, represent a lower bound on the benefits of using project finance instead of internally generated funds; $15 million is the lower bound if project finance is used instead of traditional, corporate debt.

The fact that many of these costs are relatively fixed in nature implies that it makes sense to use project finance only for large projects. But this is not always true; simple projects and those with established technologies such as power plants require less negotiation and, therefore, can be financed economically on a smaller scale.

Project Financing Reduces Information Costs

Typically, insiders know more about the value of assets in place and growth opportunities than outsiders. This information gap, when combined with incentive conflicts discussed below, creates adverse selection problems—notably, a tendency for firms to raise capital when they are overvalued—and increases the cost of raising capital.[8] These information-related costs increase with both the type (equity is more costly than debt) and amount of capital raised, and partially explain why firms rarely finance projects with external equity and why they may find it uneconomical to finance large projects with corporate debt. The costs also appear to be more important in emerging markets like Venezuela than in developed markets like the United States.[9]

The project structure is most commonly used with tangible and, therefore, relatively transparent assets. The separation of projects from the sponsoring firm or firms facilitates initial credit decisions. Instead of analyzing Petrozuata and its sponsoring organizations as a pooled credit, the creditors can analyze the project on a stand-alone basis. With a small lending syndicate and extensive negotiations, it is relatively easy to convey information that would either be more difficult with a larger group of creditors or undesirable for competitive reasons.

The transparent nature of projects also makes it relatively easy to monitor construction and development.[10] This feature distinguishes project finance from other start-up financing such as venture capital, where it is extremely difficult to monitor development. For similar reasons, it is easier to monitor a project's on-going performance. With segregated cash flows and dedicated management, there is little room for the kind of intentional or judgmental misrepresentation that is possible with diversified or consolidated firms. These improvements in transparency can lower a project's cost of capital.[11]

Project Finance Reduces Incentive Conflicts

Despite the time and effort spent on structuring deals, there are always contingencies that are either unforeseeable, or uneconomical to negotiate. This inability to write "complete" contracts, combined with the fact that it is costly to monitor and enforce contracts, creates the potential for incentive conflicts among the various participants. One of the most important reasons for using project finance is to limit the costs imposed by these conflicts.[12]

Most of these conflicts relate to investment decisions or operating efficiency. The investment distortions in particular fall into one of four categories: overinvestment in negative NPV projects (known as free cash flow conflicts); investment in high-risk, negative NPV projects (known as risk shifting); underinvestment in positive (even riskless) NPV

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6. McLaughlin (1990) finds that M&A advisory fees average 60 basis points for over $1 billion. See R.M. McLaughlin, "Investment Banking Contracts in Tender Offers," *Journal of Financial Economics*, 28 (1990):209-232.

7. These calculations are based on the ProjectFinanceWare term sheet #3164 from Capital DATA, ltd.

8. For a description of the "lemons" problem of adverse selection in asset sales, see G.A. Akerlof, "The Market for 'Lemons': Quality and the Market Mechanism," *Quarterly Journal of Economics*, 84 (970): 488-500. For a discussion of how asymmetric information inhibits equity financing and causes underinvestment, see S.C. Myers and N.S. Majluf, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have," *Journal of Financial Economics*, 13 (1984): 187-221.

9. For a discussion of the incentive and information problems in emerging markets and how institutions often replace markets in these situations, see T. Khanna and K. Palepu, "Why Focused Strategies May Be Wrong for Emerging Markets," *Harvard Business Review* (July/August, 1997), 41-51.

10. The tax advantages of R&D limited partnerships are analyzed in J. Kensinger and J. Martin Kensinger, "An Economic Analysis of R&D Limited Partnerships," *Midland Corporate Finance Journal*, (Winter, 1986), 4-46. The authors refer to these structures as project finance, but recognize that the partnerships do not use non-recourse debt, a feature that I believe defines project finance.

11. For a model of capital market equilibrium with incomplete information that shows that firms can reduce their cost of capital by removing information asymmetries, see R.C. Merton, "A Simple Model of Capital Market Equilibrium with Incomplete Information," *The Journal of Finance*, 42 (1987): 483-510.

12. Brealey, Cooper, and Habib (1996) argue that the *primary* reason for using project finance is to control these costly conflicts.

projects (known as debt overhang); and underinvestment in risky, positive NPV projects due to managerial risk aversion.[13] Studies of conglomerates suggest that inefficient investment appears to be quite common, destroys significant amount of value, and may well explain the 10-15% conglomerate discount observed in the market.[14]

Project finance helps eliminate all four investment distortions that would otherwise plague *sponsoring* organizations using corporate finance. It reduces overinvestment in negative NPV projects by requiring firms to raise external funds from independent third parties—Conoco had to raise $1.4 billion from bank and bond investors rather than funding the project internally. At the same time it reduces underinvestment due to debt overhang by assigning project returns to new investors rather than existing capital providers. To illustrate, assume that Conoco had already made full use of its existing debt capacity and, because of a downturn in oil prices, considered itself to be somewhat overleveraged. In such a case, Conoco's management might forgo a positive NPV project because covenants are likely to prevent it from issuing senior securities and because investors might not invest in junior securities (equity or subordinated debt) since they effectively transfer wealth to more senior creditors. Project finance solves this problem by assigning project returns to a new set of claimholders.[15] Finally, the project structure solves the problem of underinvestment in risky, positive NPV projects by isolating project risk and so reducing the probability of risk contamination. By risk contamination I mean the possibility that, under a conventional corporate financing, subsidiary losses would cause financial distress or even default by the parent.

The project structure also minimizes investment distortions at the *project* level. In contrast with sponsoring organizations, projects require relatively little investment once complete. With little value associated with future growth options, the danger of underinvesting is low. Far more important are the overinvestment problems that could arise under corporate finance because projects generate large cash flows; they have very low variable costs and tend to be low-cost producers. The use of high leverage in project finance, however, forces managers to disgorge free cash flow in the form of interest and principal payments thereby limiting their ability to invest. Although it solves the free cash flow problem, high leverage exacerbates the risk shifting problem. But here, too, the project structure is designed to minimize value destruction. A trustee allocates cash flows according to a predetermined "cash waterfall," leaving little room for managerial discretion.

Besides investment decisions, there are important incentive problems that relate to managerial effort: do managers act to maximize value? When one or more of the sponsors is a government-owned entity, one of the major benefits of project finance is the substitution of private-sector for public-sector management. The superiority of private-sector management is well documented in the cases of privatized companies.[16] As residual claimants with concentrated ownership claims, the sponsors have the incentive to maximize value even in the absence of complete contracts. For example, Conoco has an incentive to supply the appropriate amounts of intangible inputs such as refining technology and project management expertise. Both sponsors have an incentive to manage the risks they control efficiently (a subject I return to in the next section). To ensure managerial efficiency, there is a small board of directors comprised of two directors from each sponsor, and there are compensation contracts for managers that are linked to project performance. This combination of concentrated equity ownership and direct control prevents a wide range of incentive problems that destroy value in diversified companies.

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13. For the seminal discussion of free cash flow theory, see M.C. Jensen, "The Agency Costs of Free Cash Flow," *American Economic Review* (1986). For the theory of risk shifting, see M.C. Jensen, and W.H. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure," *Journal of Financial Economics*, 3 (1976); On debt overhang, see Myers and Majluf, (1984). For a discussion of managerial risk aversion, see C.W. Smith and R. Stulz, "The Determinants of Firms' Hedging Policies, *Journal of Financial and Quantitative Analysis*, 20 (1985).

14. For discussions of inefficient internal capital markets, see O. Lamont, "Cash Flow and Investment: Evidence from Internal Capital Markets," *The Journal of Finance*, 52 (1997): 83-109. R. Rajan, H. Servaes, and L. Zingales, "The Cost of Diversity: The Diversification Discount and Inefficient Investment," *Journal of Finance*, forthcoming; and D.S. Scharfstein and J.C. Stein, "The Dark Side of Internal Capital Markets: Divisional Rent-seeking and Inefficient Capital Investment, National Bureau of Economic Research, working paper #W5969, March 1997. For a study that documents the conglomerate discount, see P.G. Berger and E. Ofek, "Diversification's Effect on Firm Value," *Journal of Financial Economics*, 37 (1995): 39-65.

15. Stulz and Johnson (1985) make this argument for the use of secured debt while John and John (1991) make this argument for the use of project finance. See R.M. Stulz and H. Johnson, "An Analysis of Secured Debt," *Journal of Financial Economics*, 14 (1985): 501-521; and K. John and T. John, "Optimality of Project Financing: Theory and Empirical Implications in Finance and Accounting," *Review of Quantitative Finance and Accounting*, 1 (1991): 51-74.

16. For a review of the research on privatization's impact on economic performance, see J. D'Souza and W.L. Megginson, "The Financial and Operating Performance of Privatized Firms During the 1990s," *The Journal of Finance*, 54 (1999): 1397-1438.

Project Finance Reduces the Costs of Financial Distress

The cost of financial distress is an *expected* cost equal to the probability of distress times the costs associated with distress. Project finance adds value by reducing the probability of distress at the *sponsor* level and by reducing the costs of distress at the project level. I begin by comparing the probability of distress for a firm using conventional corporate finance with that of the same firm using non-recourse project finance to fund a new investment. If the firm uses corporate finance, then it becomes vulnerable to risk "contamination"; that is, the possibility that a poor outcome for the project causes financial distress for the parent. Of course, this cost is offset by the benefit of coinsurance whereby project cash flows prevent the parent from defaulting.[17] Thus, from the parent corporation's perspective, corporate finance is preferred when the benefits of co-insurance exceed the costs of risk contamination, and vice versa for project finance. Risk contamination, and hence the use of project finance, is more likely when projects are large compared to the sponsor, have greater total risk, and have high, positively correlated cash flows.[18] Petrozuata fits all three criteria. It is large relative to either sponsor (the $2.4 billion cost represents 19% and 22% of Conoco's and Maraven's identifiable assets, respectively), is very risky (as discussed below), and is likely to have cash flows that are highly correlated with its sponsors.

With regard to the costs of financial distress, sponsors use project finance in situations that have low costs of distress. Projects typically consist of economically independent, tangible assets that do not lose much value during default or following restructuring. Because the assets have few alternative uses, an efficient restructuring is more likely than an inefficient liquidation. The recognition that projects consist primarily of going concern value makes even senior claimants prefer speedy restructurings over delayed negotiations and uncertain outcomes. A final reason for low distress costs is the fact that project output is either a commodity that holds its value through restructuring or, as was the case with Petrozuata, a more specialized product that the off-taker will still want to buy. Even in a default situation, Conoco would want access to low-cost syncrude to keep its Lake Charles refinery running at full capacity.

Moreover, the structure of the project can also be designed to reduce the costs of distress. At least in developed countries, projects have relatively simple capital structures—often with a single class of bank debt—which tends to facilitate debt restructuring.[19] In contrast, projects in developing markets have significantly more complicated capital structures—in part because, as I suggest below, the presence of more participants is one way to mitigate sovereign risk.

In sum, the combination of lowering the probability of default and lowering the actual costs of default facilitates the use of high leverage. High leverage, in turn, creates further value by reducing incentive conflicts and by increasing interest tax shields.

Project Finance Reduces Corporate Taxes

The creation of an independent economic entity allows projects to obtain tax benefits that are not available to their sponsors. For example, Petrozuata will pay reduced royalty rates on oil revenue and income tax rates in exchange for using Venezuelan "content" (jobs, suppliers, contractors, etc.). Had Maraven financed the project on-balance sheet, it would have been subject to income tax rates of 67.7% and royalty rates of 16.67%. In contrast, Petrozuata will pay income taxes at the rate of 34%, and royalties at the rate of only 1% for the first nine years of operations, and no municipal taxes.[20] A 1% reduction in either the income tax rate or the royalty rate is worth approximately $4 million of incremental after-tax cash flow. Tax rate reductions and tax holidays are fairly common in project finance deals and illustrate how sponsors can capture some of the social benefits created by their project. Another tax advantage of the project structure is the incremental interest tax shields. Assuming the 60% leverage ratio

17. Brealey, Cooper, and Habib (1996) show how the use of project finance re-arranges the states of nature in which default occurs.

18. For a presentation of the model of the benefits of project finance illustrating the importance of project size, total risk, and correlation with sponsor returns, see my working paper, "Why Do Firms Use Project Finance Instead of Corporate Finance?," Harvard Business School working paper. For a study that shows that the use of project finance is positively correlated with relative project size (project size/sponsor assets) and with sovereign risk, see S. Kleimeier and W.L. Megginson, "An Economic Analysis of Project Finance," University of Oklahoma Working Paper, November 1996.

19. For a study showing that having fewer classes of debtholders facilitates restructuring, see S.C. Gilson, K. John, and L.H.P. Lang, "Troubled Debt Restructurings: An Empirical Study of Private Reorganization of Firms in Default, *Journal of Financial Economics*, 27 (1990): 315-353.

20. Standard & Poor's, 1997a, Petrozuata Finance, Inc., in Global Project Finance, September, 1997, p. 239.

The combination of concentrated equity ownership and direct control in project finance prevents a wide range of incentive problems that destroy value in diversified companies.

is twice as high as either sponsor could have achieved under corporate financing, the incremental tax shields are worth approximately $140 million when discounted at a weighted-average cost of debt of 8.0%.[21]

Petrozuata's structure does, however, have one tax disadvantage. Because it was structured as a corporation and not as a pass-through entity such as a partnership, it pays taxes at the project level. As a result, it must use early net operating losses (NOLs) to offset future income rather than using them in the year incurred. In some cases, this loss in time value can be significant even though operating expenses are low.

In conclusion, sponsors use project finance in situations where high leverage is appropriate (i.e., with projects that have predictable cash flows, low distress costs, and minimal ongoing investment requirements) and where the structure can reduce the costs associated with market imperfections. Indeed, the size of the transactions costs incurred in structuring deals suggests that the benefits from reducing information asymmetries, incentive conflicts, taxes, and distress costs must be significant.

MANAGING PROJECT RISK

The second way project finance creates value is by improving risk management. Risk management consists of identifying, assessing, and allocating risks with the goals of reducing cost and of ensuring proper incentives. The identification of project risks and the assessment of severity are typically done by the sponsors in conjunction with their financial advisors. Then, to add credibility to the process, the key assumptions are verified using independent experts. In this case, the sponsors hired three independent consultants to analyze the oil reserves, project design, construction schedule, operating costs, syncrude demand, and syncrude prices. The sponsors also reviewed various deal structures with the ratings agencies in an attempt to garner an investment grade rating for a possible bond issue.

The next step is to allocate the risks to the parties that are in the best position to influence or control the outcome. When it is possible and cost effective to do so, these risks should be allocated contractually. Even when it is impossible or too costly to write complete contracts, the same principle holds: allocate residual risks and returns to the party best able to influence the outcome. By thus joining risks and returns, you increase the probability that parties will act in ways that maximize efficiency. This disaggregation and allocation of project risks and returns, particularly the residual risks and returns, distinguishes project finance from corporate finance.

The purpose of this section is to analyze how the sponsors allocated both contractual and residual risk in the Petrozuata deal. To facilitate this analysis, I classify the risks into four general categories: pre-completion risks, operating risks, sovereign risks, and financing risks. Table 4 presents a comprehensive risk management matrix that identifies the risks and who bears them in this deal.[22]

Pre-Completion Risks

Pre-completion risks include all of the risks up to the point when a project passes a detailed set of completion tests. For example, resource, *force majeure*, technological, and timing risks are all important pre-completion risks. The risk that a key resource does not exist in the expected quantity or quality is known as resource risk. Both Conoco and PDVSA conducted initial tests to confirm the presence and quality of the oil in the Orinoco Belt, tests that were subsequently verified by an independent consultant. Based on the conclusion that Petrozuata would extract only 7% of proven reserves, analysts saw this as a development, not an exploration, project.

Force majeure risks include both "Acts of God" such as earthquakes and political risks such as war or terrorism. Acts of God, which by definition are not under any party's control, are best allocated to third-party insurers with large, well-diversified portfolios. To that end, the sponsors purchased a $1.5 billion "all-risk" insurance policy during construction, and agreed to purchase property insurance as well as business interruption insurance during the operating phase. With regard to the political risks, the sponsors did what they could through project

21. When capital structure is pre-determined and not adjusted as a function of firm value, then the appropriate discount rate for interest tax shields is the cost of debt.

22. For good overviews of project risks, see R.F. Bruner and J. Langohr, Project financing: An economic overview, Insead-Darden case study #295-026-6, 1992; and and Chapter 4 of International Finance Corporation (IFC), *Project Finance in Developing Countries*, Lessons of Experience Number 7, Washington, DC., 1999.

TABLE 4 ■ PROJECT FINANCE RISK MANAGEMENT MATRIX

Stage and Type of Risk	Description of the Generic Risk	Who Bears the Risk in This Case
PRE-COMPLETION RISKS		
Resource Risk	Inputs are not available in the quantity and quality expected	Sponsors (suppliers)
Force Majeure	"Acts of God" such as earthquakes or political risks such as war, terrorism, or strikes affect completion	3rd party insurers
Technological Risk	The technology does not yield the expected output	Sponsors (contractors)
Timing or Delay Risk	Construction falls behind schedule or is never completed	Sponsors (contractors)
Completion Risk	The combination of technological and timing risks.	Sponsors (contractors)
OPERATING RISKS (POST-COMPLETION)		
Supply or Input Risk	Raw materials are not available in the quality or quantity expected?	Sponsors (suppliers)
Throughput Risk	Ouput quantities are too low or costs are too high.	Sponsors
Force Majeure	See above	3rd party insurers or Sponsors
Environmental Risks	The project fails to comply with national and international environmental regulations	Sponsors
Market Risk: quantity	There is insufficient demand for the output	Conoco (off-taker)
Market Risk: price	Output prices decline	Sponsors (creditors)
SOVEREIGN RISKS		
Macroeconomic Risks		
1) Exchange Rates	Changes in exchange rates reduce cash flows	Sponsors Venezuelan government
2) Currency Convertibility	Inability to convert and repatriate foreign currency proceeds	Sponsors Venezuelan government
3) Inflation	Nominal contracts become vulnerable to price changes.	Sponsors Venezuelan government
Political and Legal Risks		
1) Expropriation	Government seizes the assets or cash flows directly or indirectly through taxes	Sponsors Venezuelan government
2) Diversion:	The government redirects project output or cash flows	Sponsors Venezuelan government
3) Changing Legal Rules	The government changes legal rules regarding contract enforceability, bankruptcy, etc.	Sponsors Venezuelan government
FINANCIAL RISKS		
Funding Risk	The project cannot raise the necessary funds at economical rates	Sponsors/Creditors
Interest-rate Risk	Increasing interest rates reduce cash flows	Sponsors/Creditors
Debt Service Risk	The project is unable to service its debt obligations for any reason	Sponsors/Creditors

design to mitigate these risks: the pipelines were underground and the loading facilities were underwater. As a further measure of protection against terrorism, Venezuelan troops guarded the project during construction.

Next there is the risk that the project does not work or does not meet scheduled completion, which are known as technology and timing risks, respectively. The sponsors took several steps to mitigate both risks. They selected only *proven* technologies: horizontal drilling wells were currently being used in the Orinoco Belt and elsewhere; conventional diluted oil pipelines were common; and Conoco's coking technology was used in refineries around the world. Timing risk was an even bigger concern given the project's 37-month construction schedule. Be-

Even when it is impossible or too costly to write complete contracts, the same principle holds: allocate residual risks and returns to the party best able to influence the outcome. By thus joining risks and returns, you increase the probability that parties will act in ways that maximize efficiency.

TABLE 5
1996 DEBT RATINGS AND FINANCIAL STATISTICS FOR INTEGRATED OIL COMPANIES

Company	S&P Rating	Country	Country Rating	Debt to Total Capital	Pre-tax Interest Coverage	Operating Income/ Revenue	Revenue ($ billions)
Amoco	AAA	US	AAA	27%	13.1×	18.9%	$32.2
Chevron	AA	US	AAA	32	9.9	16.9	37.6
Exxon	AAA	US	AAA	21	10.3	13.8	116.7
Mobil	AA	US	AAA	33	11.7	11.9	71.2
Texaco	A+	US	AAA	39	5.7	10.1	44.6
Shell (CN)	AA	Canada	AA+	21	6.6	19.7	5.1
PDVSA	B	Venezuela	B	15	32.3	48.7	33.9

Sources: S&P Global Sector Review and Bloomberg.

cause the project involved the three distinct components, the sponsors were unlikely to find a general contractor willing to sign a fixed-price, date-certain, turnkey contract for the entire project. As a result, Petrozuata itself became the general contractor. Both Conoco and PDVSA felt comfortable bearing this risk because both firms had experience managing large oil-field development projects in emerging markets. Conoco had recently completed the $440 million Ardalin project in Arctic Russia and the $3.5 billion Heidrun project in Norway; PDVSA had recently completed the $2.7 billion expansion of its Cardón refinery. Where possible, the sponsors planned to use sub-contractors subject to fixed-price engineering, procurement, and construction (EPC) contracts to shift some of the completion risk to other parties. To protect against other shortfalls, they incorporated two contingency funds into the budget representing approximately 9% of upstream (wells and pipelines) and 15% of downstream (upgrader) construction costs (which are shown in Table 3 earlier).[23]

Despite these features, debtholders still wanted some guarantee that the project would be completed on time and on budget. These concerns were not unreasonable. According to one study of 230 greenfield projects in developing countries, 45% of them had cost overruns.[24] To address these concerns, Conoco and Maraven severally guaranteed to pay project expenses, including any unexpected cost overruns, prior to completion.[25] The parent corporations, DuPont (rated AA-) and PDVSA (rated B), guaranteed these obligations. The guarantees remain in effect until the project successfully passes six completion tests, three of which must be approved by an independent engineering firm. The most restrictive test requires the project to produce syncrude at pre-determined quantities and qualities for a period of 90 days.

Given the difference in ratings between the two sponsors, this guarantee structure was unique. More typical completion guarantees involved either a letter of credit covering the lower-rated sponsor's obligation or a *joint* guarantee with a fee paid by the lower-rated to the higher-rated sponsor. One reason for structuring a several guarantee was that PDVSA saw itself as a strong credit despite its B rating. In fact, according to one company official, "PDVSA would have a AAA rating if it were located in the U.S.; but because it was in Venezuela and its lone shareholder was the Venezuelan government, it's rating was capped by the sovereign's rating." Although Table 5 shows there is some merit for this view, based solely on recent financial ratios relative to other major oil companies, the rating agencies still considered PDVSA's B rating as a "weak link" in the project.

The completion guarantee ensures that the sponsors bear residual completion risk. This allocation makes sense given their position as the *general* contractors, their construction experience, their knowledge of refining technology, and their position as equity investors. Rather than trying to specify every possible construction contingency, which

23. Sponsors typically sign engineering, procurement, and construction (EPC) contracts containing liquidated damages to cover cost overruns and delays. These guarantees cover from 15-40% of costs depending on the type of project.

24. IFC (1999), pp. 43-44.

25. Under a several guarantee, each sponsor is responsible for its share of total costs based on ownership, but is not liable for its partners' shares. In contrast, a joint guarantee means that each party is potentially liable for the entire amount.

would have been prohibitively expensive if not impossible, the sponsors elected to assume completion risk themselves as the low-cost alternative.

Because they are residual claimants in the project, one can assume they will develop the project optimally, particularly with regard to the project's embedded optionality. Like all development projects, the developer has the option to defer, change, and/or abandon the project. While a complete real options analysis of this project would be helpful and interesting, it is beyond the scope of this paper. Instead, I simply note that the abandonment option is quite different in the context of large-scale project development.[26] Staged investment, which is common in venture capital, is not as valuable in this context because most projects have low salvage values and intermediate stages of completion do not reveal much about underlying demand.[27] Moreover, sponsors have limited ability to change scale or technologies once construction has begun given the specific nature of the projects. This lack of flexibility presents a significant impediment to project sponsors and helps explain why many projects have poor financial returns—witness the bankruptcies of EuroTunnel, EuroDisney, Iridium, and ICO Communications.

Operating or Post-Completion Risks

Once a project has successfully passed its completion tests, then input, throughput, environmental, and output risks become relevant (*force majeure* risks are always present). Input or supply risk refers to shortfalls in the quantity or increases in the price of critical raw materials. Petrozuata's primary input is crude oil which, as discussed earlier, was in plentiful and inexpensive supply. Other raw materials, including labor, water, electricity, and gas, represent a small fraction of total costs and, with the exception of labor, are produced by the project itself subject to long-term contract.

Given appropriate inputs, daily operations are then subject to throughput and environmental risks. The ability to produce syncrude at projected costs and qualities is known as throughput risk. Once again, an independent consulting firm verified the operations prior to construction. It concluded that the system, with proper maintenance, would produce syncrude at expected costs for the life of the project barring *force majeure* events. Similarly, the project was reviewed carefully to ensure compliance with all applicable domestic and World Bank environmental standards. The sponsors play an important role in mitigating operating risks, a role they take seriously given their status as junior claimants. They are responsible for maintaining the equipment, operating it efficiently, and complying with environmental regulations.

Finally, there are the risks that the demand or price of syncrude falls. Conoco assumed the demand risk through the off-take agreement guaranteed by DuPont. Having a AA-rated entity such as DuPont guarantee demand made Petrozuata look like a utility with a guaranteed market, and reduced a key determinant of cash flow variability, something the rating agencies would expect in an investment-grade project. From a risk management perspective, Conoco was an ideal party to bear the quantity risk because it needed feedstock for its Lake Charles refinery in Louisiana. In addition, Conoco, as one of the major competitors in the developing market for syncrude, was likely to know more about the developing syncrude market than most other firms.[28]

One of the most curious aspects of this tightly structured deal is the fact that the sponsors chose not to fix the price of syncrude, particularly given the historical volatility of Maya crude prices, the marker for setting syncrude prices. (Figure 1 shows Maya crude prices since 1983). Failure to lock in a price exposed the project to not only price risk, but also to a form of basis risk in the event that syncrude traded at an increasing discount to other crude oils. One alternative was to fix the price in the off-take agreement, but Conoco did not want to assume this risk. A second alternative was to fix the price using derivative instruments, but the sponsors rejected this alternative as being too expensive given the absence of long-term futures contracts for Maya crude—and too risky given the need to use an imperfectly correlated hedging instrument.

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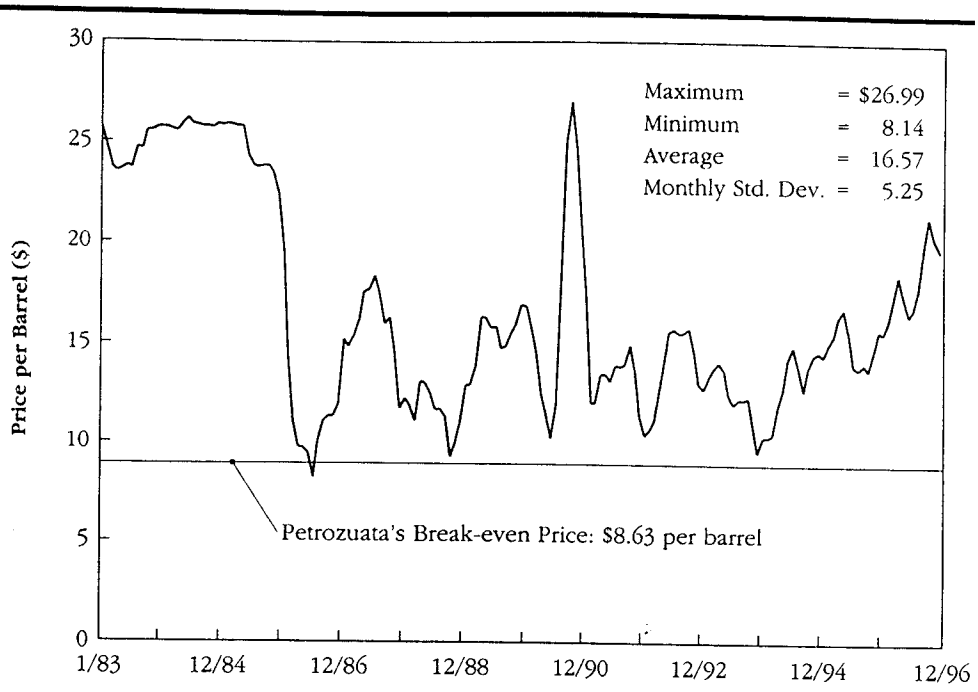
26. For a discussion of how to value the abandonment option, see S.C. Myers and S. Majd, "Abandonment Value and Project Life," *Advances in Futures and Options Research*, 4 (1990):1-21.

27. For an analysis of the staging of investment in venture capital organizations, see W.A. Sahlman, "The Structure and Governance of Venture-capital Organizations," *Journal of Financial Economics*, 27 (1990): 473-521.

28. For a discussion of how vertical integration provides information that helps firms make better capacity and production investment decisions, see K.J. Arrow, Vertical integration and communication, *The Bell Journal of Economics*, 6 (1975): 173-183.

While mitigating completion and operating risks is important, project finance is most valuable as an instrument for mitigating sovereign risks. Indeed, it is the one feature that cannot be replicated under conventional corporate financing schemes.

FIGURE 1
MAYA CRUDE OIL PRICES



Source: Energy Information Administration.

The final, and chosen, alternative was to let the sponsors bear this risk, which they agreed to do because of a number of mitigating factors. First, an independent consulting firm confirmed that the pricing projections were both reasonable and consistent with market expectations. Second, Petrozuata was a low-cost producer: its break-even price was well below the industry average, which meant it could still operate profitably even if prices fell dramatically.[29] And third, the financial advisors conservatively assumed a 1996 syncrude price of $12.25 per barrel compared to a current Maya crude price of over $15.00—and even though they believed that syncrude would trade above the Maya price. Thus, there was significant leeway for price declines. In fact, the nominal price of Maya crude had fallen below Petrozuata's break-even price of $8.56 per barrel only once since 1983, and even then it remained below the break-even price for only a month or so. After subjecting the project to this "backcast" of oil prices, and seeing it could survive, the sponsors agreed to accept the price risk. The expectation of increasing oil prices and, therefore, higher equity returns were enough to offset this risk.

Sovereign Risks

While mitigating completion and operating risks is important, project finance is most valuable as an instrument for mitigating sovereign risks. Indeed, it is the one feature that cannot be replicated under conventional corporate financing schemes. Sovereign risk was one of the biggest concerns about the Petrozuata deal because of Venezuela's historical macroeconomic and political instability. The bolivar had depreciated dramatically over the past few years; the government had restricted currency convertibility between 1994 and 1996, causing several firms to default on foreign currency obligations; and inflation was running rampant (see Table 6). Venezuela had also experienced more than a decade of political turmoil, including two failed military coups, a presidential impeachment, and a banking crisis. This level of uncertainty plus the history of nationalization in the 1970s made investors leery of investing in Venezuela.

In referring to this situation, one analyst referred to Petrozuata as "a great project in a bad neighborhood." Table 7 shows sovereign credit ratings for

29. Standard & Poor's (1997a), pp. 242-243.

TABLE 6
VENEZUELAN MACROECONOMIC DATA: 1990-96

Year	Real GDP Growth	Gov't Surplus as % of GDP	Oil Exports as % of Total Exports	Oil Exports as % of GDP	Unemployment Rate	Inflation Rate	Long-term Debt Rates	Exchange Rate (bolivar per $US)
1990	7.5%	(2.1%)	80.0%	29.2%	11.0%	40.6%	20.1%	50.38
1991	10.1	(1.4)	81.1	23.1	10.1	34.2	27.1	61.55
1992	7.4	(3.8)	79.0	18.7	8.1	31.4	31.7	79.45
1993	(0.6)	(2.5)	74.7	18.0	6.8	38.1	41.0	105.64
1994	(2.5)	(6.8)	72.7	20.2	8.9	60.8	54.7	170.00
1995	3.7	(4.6)	74.4	17.9	10.9	59.9	53.4	290.00
1996	(0.4)	0.2	80.4	26.7	12.3	99.9	49.9	476.50

Sources: Inter-American Development Bank and the International Monetary Fund (IMF).

TABLE 7
SOVEREIGN CREDIT RATINGS*

Sovereign	Standard & Poor's 12/94	Standard & Poor's 12/96	Moody's 12/94	Moody's 12/96	Institutional Investor[a] 9/94	Institutional Investor[a] 9/96
NORTH AMERICA						
Canada	AA+	AA+	Aa1	Aa1	81.3	79.4
Mexico	BB	BB	Baa1	Baa1	46.1	41.6
United States	AAA	AAA	Aaa	Aaa	90.8	90.7
CENTRAL AMERICA						
Costa Rica	n/r	n/r	n/r	n/r	30.3	33.9
Panama	n/r	n/r	n/r	n/r	24.3	28.5
SOUTH AMERICA						
Argentina	BB–	BB–	B2	B1	37.3	38.9
Bolivia	n/r	n/r	n/r	n/r	21.4	25.4
Brazil	B+	B+	B1	B1	30.3	38.3
Chile	BBB+	A-	Baa2	Baa1	54.9	61.2
Colombia	n/r	BBB–	n/r	Baa3	44.4	46.7
Ecuador	n/r	n/r	n/r	n/r	24.5	26.4
Peru	n/r	n/r	n/r	B3	21.0	30.0
Venezuela	B+	B	Ba2	Ba2	36.0	32.0

Sources: Bloomberg; and "Country Credit Ratings," Institutional Investor, March 1995 and September 1996.
*Ratings are an assessment of the government's capacity and willingness to repay foreign currency denominated long-term debt. n/r = not rated.
a. Institutional Investor's "Country Credit Ratings" are based on a survey of 75 to 100 international banks. Bankers are asked to grade each country on a scale from 0 to 100 with 100 representing the least chance of default.

various North, Central, and South American countries. Venezuela's sub-investment grade ratings—B by S&P and Ba2 by Moody's—reflected this concern. Venezuela was also the only South American country to be downgraded by both S&P and Institutional Investor during the prior two years. Given the perception of sovereign risk, PDVSA, as a state-owned entity, had its rating capped at the sovereign B rating. The logic for capping corporate ratings is based on historical data; S&P, for example, reported finding that 68% of private sector defaults were triggered by sovereign defaults.[30]

30. Standard & Poor's, Understanding Sovereign Risk, Standard & Poor's Credit Week, 1/1/97, p. 3.

Although the deal had many features to mitigate sovereign risks, one of the key features was the decision to keep oil revenues out of the country.

Although the deal had many features to mitigate sovereign risks, one of the key features was the decision to keep oil revenues out of the country. Conoco as the purchaser would deposit U.S. dollar proceeds with a trustee in New York who would disburse cash according to the "waterfall" described earlier. An added benefit of this structure is that it effectively eliminated exchange rate risk because the revenues and debt service were both denominated in dollars. It also helped justify the inclusion of a provision for international, not Venezuelan, arbitration for disputes.

An equally important factor was the decision to make the Venezuelan government, through PDVSA and Maraven, a project sponsor. The Venezuelan government has more influence over political and economic factors than any other entity. Accordingly, it should bear responsibility for mitigating sovereign risk. If the government fails to mitigate these risks, then it will lose the monetary benefits from taxes, royalties, and dividends as well as the accompanying benefits of increased employment and access to refining technology. In the extreme, Venezuela could lose access to foreign investment for another 20 years. In the presence of the country's $65 billion oil-field development initiative, Petrozuata can be seen as a strategic asset that the country could not afford to lose. Nevertheless, the risk of expropriation would rise significantly once the other Orinoco Belt projects were complete.[31] For this reason, the rating agencies were unlikely to give the project a high investment grade rating.

Investors and creditors could draw further comfort from the fact that PDVSA was more vulnerable to retaliation in 1996 than in 1976. Approximately 20% of its assets (worth $8 billion at book value) were located outside of Venezuela, including CITGO Petroleum Corporation, its retail gas distribution network. Even if retaliation were unlikely, the Venezuelan government would have trouble finding buyers for syncrude. Only a handful of refineries could process this type of heavy crude, none of which existed in Venezuela. The only refineries that could process it economically were located on the Gulf Coast of the United States, and they would be unlikely to participate in processing diverted or expropriated crude.

Finally, the project structure itself offers advantages in sovereign risk mitigation that are not available under corporate finance structures.[32] As highly leveraged, non-recourse entities, projects are vulnerable to adverse sovereign acts, even partial acts of expropriation such as increased royalty rates. The object is to structure the project in such a way so that such acts result in default, inflict losses on creditors, and cause a significant reduction in project value (i.e. the loss of critical management expertise). In contrast, a corporate-financed project might survive an act of partial expropriation due to co-insurance from the parent corporation. The use of high leverage also ensures that there is little cash left in the company to attract unwarranted attention. Researchers have advanced similar arguments to explain why unionized companies have higher debt ratios than non-unionized companies.[33] The final reason why the project structure helps mitigate sovereign risk is that it facilitates participation by local governments, local financial institutions, multilateral agencies like the International Finance Corporation (IFC), and bilateral agencies like the U.S. Export-Import Bank.

Financial Risks

There are three primary financial risks: interest-rate risk, funding risk, and credit risk. Initially, the sponsors hoped to finance 70% of the project with either fixed-rate bonds or bank loans with interest-rate swaps to deal with interest-rate risk. The idea was to transfer interest-rate risk to insurance companies and other investment fund managers that could use the fixed-rate bonds to offset long-term liabilities. (As shown in Table 8, the major investors in the bond tranches were insurance companies and other money managers.) Other advantages of bond finance include fewer covenants, greater economies of scale in issuance, and possibly better equity returns.

While these benefits were attractive and were the reasons why the sponsors chose to issue bonds, there are disadvantages of using bonds. One disad-

31. For a discussion that refers to the increasing probability of expropriation due to the declining benefits accruing to a sovereign nation as the "obsolescing bargain," see R. Vernon, *Sovereignty at Bay: The Multinational Spread of US Enterprises*, (Basic Books, New York, NY, 1971).

32. Kleimeier and Megginson (1996) show that the use of project finance is strongly positively correlated with country risk scores.

33. For a study showing how leverage can be used to protect shareholder wealth from the threat of unionization, and presenting empirical evidence consistent with their theory, see S.G. Bronars and D.R. Deere, "The Threat of Unionization, the Use of Debt, and the Preservation of Shareholder Wealth," *The Quarterly Journal of Economics* (1991) 232-254.

TABLE 8
PETROZUATA DEBT FINANCING

	Bank Financing		Bond Financing		
	Tranche A	**Tranche B**	**Series A**	**Series B**	**Series C**
Amount (billions)	$250	$200	$300	$625	$75
S&P Rating			BBB–	BBB–	BBB–
Tenor/Maturity (years)	12	14	12	20	20.25
LIBOR Margin (bps)	113-150[a]	125-200[a]			
Bank loan rates	7.94%[b]	7.94%[b]			
Benchmark Treasury			10 year	30 year	30 year
Spread over Treasuries (bps)			120	145	160
Bond rates			7.63%	8.22%	8.37%
Average Life (years)	8	10	9.7	16.5	bullet
Investors (% by series)					
Investment Advisors			53.4%	50.4%	11.3%
Insurance Companies			32.3	37.0	79.3
Banks/Trusts			4.7	4.9	2.7
Mutual Funds			4.0	4.8	6.7
Other			5.6	2.9	0.0

Source: Presentation by Jonathan Bram, CS First Boston, at the Emerging Markets Investor Conference, 11/18/97.
a The margins vary because the bank loans have step-up pricing through time.
b Bank loan rates are the weighted average step-up coupon (fixed equivalent) for both tranches.

vantage is negative arbitrage. In contrast to bank facilities that can be drawn on as needed to match construction expenses, bonds are issued in lump sum. The interest cost on unused funds invariably exceeds the interest income. A rough estimate of the negative arbitrage cost in this case is $10 million. The use of bonds can also result in diminished monitoring; a large group of well-diversified bondholders are less effective monitors than bankers and are potentially less effective at reducing sovereign risks.[34] And, in the event of financial trouble, reorganizing bondholders' claims is likely to be a more costly and time-consuming process than gaining agreement among a group of banks. A third, and potentially more serious, risk of using bond finance is that the bond market, particularly the market for developing country bonds, is very fickle. It can quickly turn "cold," forcing sponsors to resort to alternative financial structures in spite of months or years of preparation. The inability to raise funds on an economic basis and in a timely manner is known as funding risk, a risk the sponsors managed by executing a multi-pronged financial strategy. The financial advisors held simultaneous meetings with commercial banks, development agencies, and bond investors to ensure they had alternatives in the event one source or another became unavailable.

One reason why funding risk occurs is that it is very costly, if not impossible, to issue sub-investment grade project bonds. Through the course of a series of meetings with the ratings agencies, the sponsors adjusted deal terms until they created an investment-grade structure, all the while being cognizant of their equity returns. First, they discussed whether to use 60% or 70% leverage. They chose 60% leverage to show their commitment to the project and to improve the project's minimum debt service coverage ratios (DSCR).[35] To provide further safety to the debtholders, the sponsors also created a debt service reserve account (DSRA) equal to six months of principal and interest on the senior (bank) debt. Next, they discussed the completion guarantee; should it be several or joint? And finally, they altered the regulations governing the distribution of proceeds to include a "cash trap." This feature prevented cash distributions to equityholders if the project did

34. For a model of financial intermediation that explains the role of banks as delegated monitors, see D.W. Diamond, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 1984, 393-414.

35. For a discussion of how equityholders can signal project quality by increasing their investment in risky projects, see H. E. Leland and D.H. Pyle, "Information Asymmetries, Financial Structure, and Financial Intermediation," *The Journal of Finance*, 32 (1977): 371-387.

Project finance expands debt capacity because it represents a superior governance structure that results in greater efficiency and value. This creation of value occurred not because PDVSA invested in Petrozuata, but rather because it structured Petrozuata as a project.

not have a trailing and leading 12-month DSCR of more than 1.35.

This negotiation process between the sponsors, rating agencies, various types of debt providers, and other deal participants helps explain why it can take up to five years and $15 million of advisory fees to structure a deal. What makes this process especially time-consuming is the fact that small changes in deal structure ripple through and affect other participants in possibly major ways. With as many as 15 or more distinct entities involved, each having distinct preferences and risk/reward trade-offs, it is somewhat surprising they ever reach agreement.

BETTER FINANCIAL EXECUTION

The time and energy spent structuring the deal was rewarded when financing closed in June 1997. The sponsors achieved high leverage ratios, attracted new sources of capital, and obtained better pricing than previous deals. The project's 60% leverage ratio was well in excess of either parent corporation's leverage ratio: PDVSA and DuPont had book value debt to total capital ratios of 16% and 45%, respectively. The fact that a sponsor with 16% leverage could finance an asset with 60% leverage and get a higher rating is often asserted as evidence that project finance expands a firm's debt capacity. Project finance expands debt capacity because it represents a superior governance structure that results in greater efficiency and value. This creation of value occurred not because PDVSA invested in Petrozuata, but rather because it structured Petrozuata as a project.

Petrozuata was also able to attract new sources of capital. The project raised $1 billion in Rule 144A project bonds in an offering that was oversubscribed by more than *five* times! The bonds received an investment grade rating from each of the major rating agencies: Baa1, BBB-, and BBB+ from Moody's, S&P, and Duff & Phelps, respectively. Astonishingly, this transaction pierced the sovereign ceiling by five notches—Petrozuata's BBB- project rating as compared to Venezuela's B rating. Only a few prior deals, notably Ras Laffan, have managed to pierce the sovereign ceiling, though Ras Laffan did it in an investment grade country (Qatar) and by only one notch. The Petrozuata financing received recognition as the highest-rated Latin American project bond, the largest emerging market bond offering from a sub-investment grade country, and the second largest emerging market financing in history after Ras Laffan.

Petrozuata also achieved better pricing and longer maturities than previous deals (Table 8 provides highlights of the financing). The project bonds had the tightest spreads and longest maturities (25 years) of any Rule 144A project bond while the bank debt had the tightest spreads and the longest tenor (14 years) of any uncovered (without political risk insurance) bank financing. In the beginning, the sponsors thought they would need covered bank loans. Yet in the end, they had commitments for $5 billion in *uncovered* bank financing, of which they chose to use $450 million to minimize the effects of negative arbitrage and to familiarize bankers with PDVSA for future deals.

Taken as a whole, the project structure permitted far superior financial execution than had previously been achieved in the project finance market or could have been achieved using corporate finance. Virtually every major business publication covering project finance, including *Institutional Investor, Corporate Finance, Global Finance, Latin Finance,* and *Project Finance International,* selected this transaction as "1997 Deal of the Year"—and one of them, *ProjectFinance,* selected it as "Deal of the Decade." Here are three examples of what analysts had to say about he deal:

This project is a stunning achievement for the sponsors and for Venezuela.[36]

Scores of bankers not even involved in the deal refer to it as the best ever been done in the project finance sector. And for good reason.[37]

Petrozuata's feat in raising funds is nothing short of amazing. In terms of the amounts taken from both the bank and bond markets, the tenors achieved, pricing, and the structure of the project itself, the package has no parallel.[38]

Based on Petrozuata's success, PDVSA has financed several other projects in the Orinoco Belt. In June 1998, it financed the $1.7 billion Cerro Negro project; in August 1998, it financed the first

36. *Oil and Gas Journal,* 2-23-98, p. 50.
37. *Euroweek,* 1/98, p. 312.
38. *IFR,* "Review of the Year," 1997.

round of the $4.6 billion Sincor project. After the emerging markets crashed in August 1998, however, PDVSA canceled additional rounds of financing for Sincor and a fourth project known as Hamaca. A few months later, in December 1998, S&P downgraded Petrozuata to BB+ citing schedule delays, lower than expected early production revenues, cost overruns totaling $430 million (as of October 1999, the project is $553 million over budget but is on schedule), falling crude prices, and political uncertainty surrounding the presidential elections—a former coup leader was the leading candidate. Conoco and Maraven have agreed to fund the cost overruns with additional equity as required by the completion guarantee.

CONCLUSION

Petrozuata is an example of the effective use of project finance for several reasons. First, the analysis shows a typical setting where project finance is likely to create value, that of a large-scale investment in greenfield assets. Although Petrozuata involves a collection of assets (wells, pipelines, and upgrader) that is somewhat unique, the collection still represents a stand-alone economic entity. Given the nature of this investment, one can think of project finance as venture capital for fixed assets except that the investments are 100 to 1000 times larger.

Besides highlighting the types of assets appropriate for project finance, the analysis illustrates the sizeable transactions costs associated with structuring a deal as well as the full range of benefits accruing to project sponsors. The structure allows sponsors to capture tax benefits not otherwise available, lowers the overall cost of financial distress, and resolves costly incentive conflicts. Further analysis of the explicit contractual terms reveals a careful allocation of project risks in an attempt to elicit optimal behavior by each of the participants. In his 1996 book on project finance, John Finnerty aptly describes this process as "asset-based financial engineering."[39] In the end, this process of financial engineering resulted in superior financial execution and increased value for the sponsoring organizations. One achievement in particular, the sponsor's ability to issue a $1 billion bond for a project in a developing country, is both an example of and a testament to the innovation taking place in this field.

The adverse circumstances following financial closure provide further evidence of the durability and merits of the project structure. As designed, the costs are falling on the parties most responsible for influencing the events or dealing with their consequences. The sponsors bear the risks of cost overruns and declining oil prices; the Venezuelan government is responsible for increased political risk. Chávez's election as President and his attempts to consolidate power have instituted a renewed level of uncertainty that is scaring off foreign investment and may prevent further investment in the Orinoco Belt. Adebayo Ogunlesi, CS First Boston's global head of project finance, commented on the ability of projects to withstand adversity:

Consistently, project assets outperform sovereigns in crises. Paiton bonds declined much less than the Indonesian sovereign issue did. TransGas and Cenralgas performed better than the Colombian sovereign.[40]

Another way to judge the merits of this deal in particular and of project finance in general is to ask whether an alternative structure would have generated the same level of benefits, but done a better job of handling adversity. I think the answer to this question is quite clearly no, which helps explain why firms invested almost $100 billion in project finance deals last year and are likely to invest even more in the years ahead.

39. J.D. Finnerty, *Project Financing: Asset-based Financial Engineering*, (New York: John Wiley & Sons, 1996).

40. "The New Paradigms of Project Finance," *Global Finance*, August, 1998, p. 33.

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